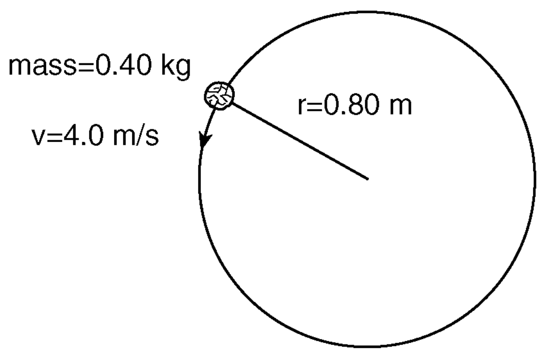
1. A net force of 25 newtons is applied horizontally to a 10.-kilogram block resting on a table. What is the magnitude of the acceleration of the block?
(1) 0.0 m/s^2 (3) 0.40 m/s^2
(2) 0.26 m/s^2 (4) 2.5 m/s^2

2. The speed of a car is increased uniformly from 20. meters per second to 30. meters per second in 4.0 seconds. The magnitude of the car's average acceleration in this 4.0-second interval is
(1) 0.40 m/s^2 (3) 10. m/s^2
(2) 2.5 m/s^2 (4) 13 m/s^2

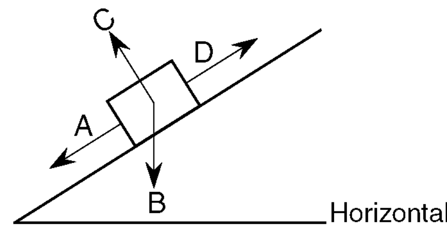
3. A roller coaster, traveling with an initial speed of 15 meters per second, decelerates uniformly at –7.0 meters per second^2 to a full stop. Approximately how far does the roller coaster travel during its deceleration?
(1) 1.0 m (3) 16 m
(2) 2.0 m (4) 32 m

4. The diagram below represents a 0.40-kilogram stone attached to a string. The stone is moving at a constant speed of 4.0 meters per second in a horizontal circle having a radius of 0.80 meter.



The magnitude of the centripetal acceleration of the stone is
(1) 0.0 m/s^2 (3) 5.0 m/s^2
(2) 2.0 m/s^2 (4) 20. m/s^2

5. In the diagram below, a box is at rest on an inclined plane.

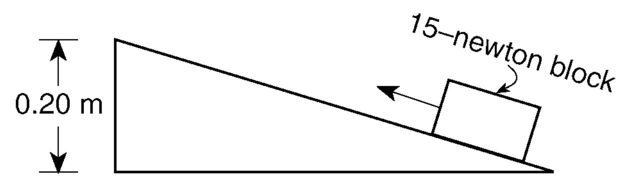


Which vector best represents the direction of the normal force acting on the box?
(1) *A* (3) *C*
(2) *B* (4) *D*

6. If the magnitude of the gravitational force of Earth on the Moon is *F*, the magnitude of the gravitational force of the Moon on Earth is
(1) smaller than *F* (3) equal to *F*
(2) larger than *F*

7. Which term represents a scalar quantity?
(1) distance (3) force
(2) displacement (4) weight

8. A block weighing 15 newtons is pulled to the top of an incline that is 0.20 meter above the ground, as shown below.

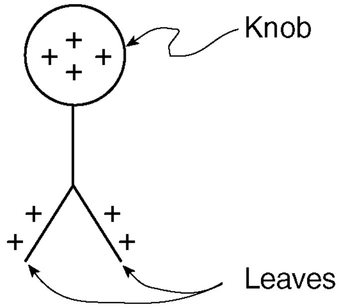


If 4.0 joules of work are needed to pull the block the full length of the incline, how much work is done against friction?
(1) 1.0 J (3) 3.0 J
(2) 0.0 J (4) 7.0 J

9. A 1.0-kilogram rubber ball traveling east at 4.0 meters per second hits a wall and bounces back toward the west at 2.0 meters per second. Compared to the kinetic energy of the ball before it hits the wall, the kinetic energy of the ball after it bounces off the wall is
(1) one-fourth as great (3) the same
(2) one-half as great (4) four times as great

10. As a spring is stretched, its elastic potential energy
(1) decreases (3) remains the same
(2) increases

11. An electroscope is a device with a metal knob, a metal stem, and freely hanging metal leaves used to detect charges. The diagram below shows a positively charged leaf electroscope.



As a positively charged glass rod is brought near the knob of the electroscope, the separation of the electroscope leaves will

(1) decrease (3) remain the same
(2) increase

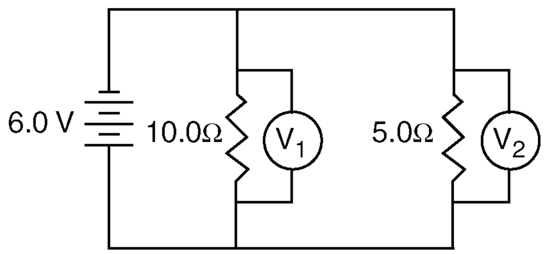
12. A catapult with a spring constant of 1.0×10^4 newtons per meter is required to launch an airplane from the deck of an aircraft carrier. The plane is released when it has been displaced 0.50 meter from its equilibrium position by the catapult. The energy acquired by the airplane from the catapult during takeoff is approximately

(1) 1.3×10^3 J (3) 2.5×10^3 J
(2) 2.0×10^4 J (4) 1.0×10^4 J

13. A 10.-ohm resistor and a 20.-ohm resistor are connected in series to a voltage source. When the current through the 10.-ohm resistor is 2.0 amperes, what is the current through the 20.-ohm resistor?

(1) 1.0 A (3) 0.50 A
(2) 2.0 A (4) 4.0 A

14. In the circuit diagram below, what are the correct readings of voltmeters V_1 and V_2?



(1) V_1 reads 2.0 V and V_2 reads 4.0 V
(2) V_1 reads 4.0 V and V_2 reads 2.0 V
(3) V_1 reads 3.0 V and V_2 reads 3.0 V
(4) V_1 reads 6.0 V and V_2 reads 6.0 V

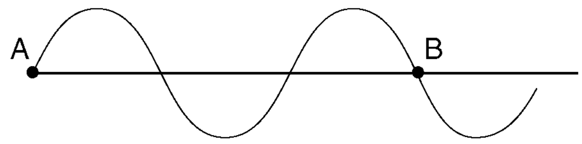
15. A physics student notices that 4.0 waves arrive at the beach every 20. seconds. The frequency of these waves is

(1) 0.20 Hz (3) 16 Hz
(2) 5.0 Hz (4) 80. Hz

16. An electric guitar is generating a sound of constant frequency. An increase in which sound wave characteristic would result in an increase in loudness?

(1) speed (3) wavelength
(2) period (4) amplitude

17. The diagram below shows two points, *A* and *B*, on a wave train.



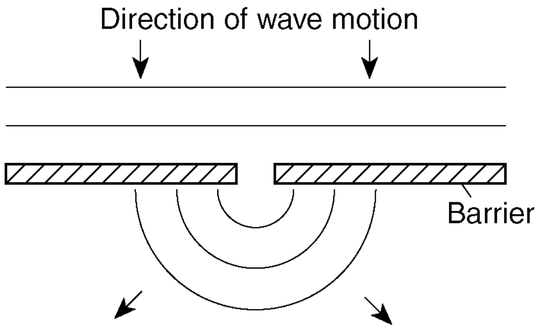
How many wavelengths separate point *A* and point *B*?

(1) 1.0 (3) 3.0
(2) 1.5 (4) 0.75

18. In a demonstration, a vibrating tuning fork causes a nearby second tuning fork to begin to vibrate with the same frequency. Which wave phenomenon is illustrated by this demonstration?

(1) the Doppler effect (3) resonance
(2) nodes (4) interference

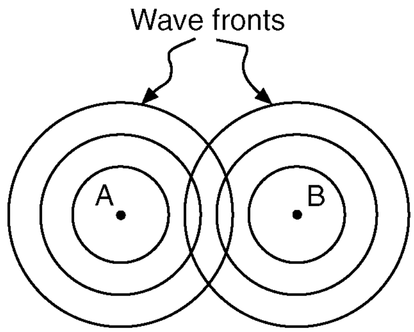
19. The diagram below shows wave fronts spreading into the region behind a barrier.



Which wave phenomenon is represented in the diagram?

(1) reflection (3) diffraction
(2) refraction (4) standing waves

20. The diagram below represents the wave pattern produced by two sources located at points *A* and *B*.



Which phenomenon occurs at the intersections of the circular wave fronts?

(1) diffraction (3) refraction
(2) interference (4) reflection

21. How much work is required to move a single electron through a potential difference of 100. volts?

(1) 1.6×10^{-21} J (3) 1.6×10^{-17} J
(2) 1.6×10^{-19} J (4) 1.0×10^{2} J

22. An object can *not* have a charge of

(1) 3.2×10^{-19} C (3) 8.0×10^{-19} C
(2) 4.5×10^{-19} C (4) 9.6×10^{-19} C

23. After electrons in hydrogen atoms are excited to the $n = 3$ energy state, how many different frequencies of radiation can be emitted as the electrons return to the ground state?

(1) 1 (3) 3
(2) 2 (4) 4

24. What type of nuclear force holds the protons and neutrons in an atom together?

(1) a strong force that acts over a short range
(2) a strong force that acts over a long range
(3) a weak force that acts over a short range
(4) a weak force that acts over a long range

25. Which is an acceptable unit for impulse?

(1) N•m (3) J•s
(2) J/s (4) kg•m/s

26. The centers of two 15.0-kilogram spheres are separated by 3.00 meters. The magnitude of the gravitational force between the two spheres is approximately

(1) 1.11×10^{-10} N (3) 1.67×10^{-9} N
(2) 3.34×10^{-10} N (4) 5.00×10^{-9} N

27. During a collision, an 84-kilogram driver of a car moving at 24 meters per second is brought to rest by an inflating air bag in 1.2 seconds. The magnitude of the force exerted on the driver by the air bag is approximately

(1) 7.0×10^{1} N (3) 1.7×10^{3} N
(2) 8.2×10^{2} N (4) 2.0×10^{3} N

28. An apple weighing 1 newton on the surface of Earth has a mass of approximately

(1) 1×10^{-1} kg (3) 1×10^{1} kg
(2) 1×10^{0} kg (4) 1×10^{2} kg

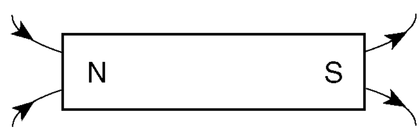
29. In raising an object vertically at a constant speed of 2.0 meters per second, 10. watts of power is developed. The weight of the object is

(1) 5.0 N (3) 40. N
(2) 20. N (4) 50. N

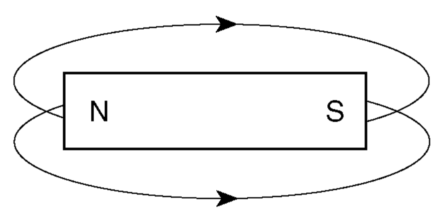
30. Which diagram best represents magnetic flux lines around a bar magnet?

(1)

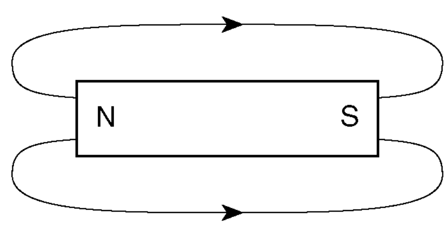
(2)



(3)



(4)



31. In which situation is the net force on the object equal to zero?

(1) a satellite moving at constant speed around Earth in a circular orbit
(2) an automobile braking to a stop
(3) a bicycle moving at constant speed on a straight, level road
(4) a pitched baseball being hit by a bat

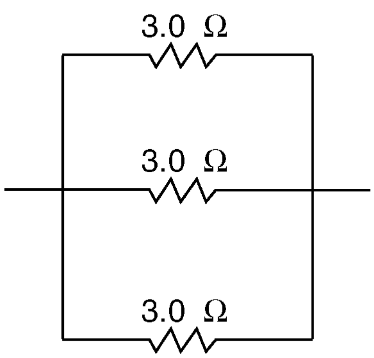
Base your answers to questions **32** and **33** on the information below.

A 2.00×10^6-hertz radio signal is sent a distance of 7.30×10^{10} meters from Earth to a spaceship orbiting Mars.

32. Approximately how much time does it take the radio signal to travel from Earth to the spaceship?
    (1) 4.11×10^{-3} s
    (2) 2.43×10^{2} s
    (3) 2.19×10^{8} s
    (4) 1.46×10^{17} s

33. The spaceship is moving away from Earth when the radio signal is received. Compared to the frequency of the signal sent from Earth, the frequency of the signal received by the spaceship is
    (1) lower
    (2) higher
    (3) the same

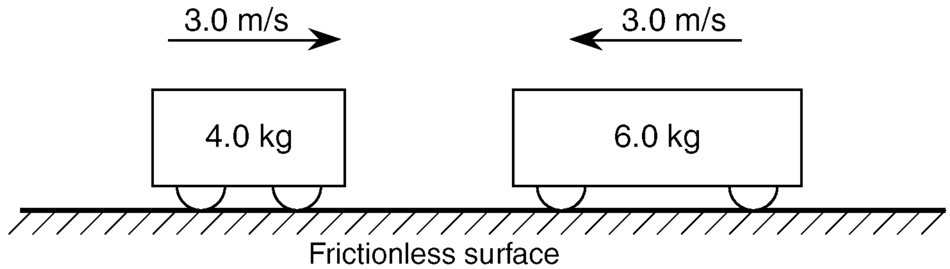
34. What is the total resistance of the circuit segment shown in the diagram below?



    (1) 1.0 Þ
    (2) 9.0 Þ
    (3) 3.0 Þ
    (4) 27 Þ

35. What is the approximate electrostatic force between two protons separated by a distance of 1.0×10^{-6} meter?
    (1) 2.3×10^{-16} N and repulsive
    (2) 2.3×10^{-16} N and attractive
    (3) 9.0×10^{21} N and repulsive
    (4) 9.0×10^{21} N and attractive

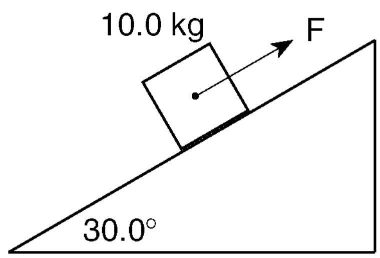
36. The diagram below shows a 4.0-kilogram cart moving to the right and a 6.0-kilogram cart moving to the left on a horizontal frictionless surface.



When the two carts collide they lock together. The magnitude of the total momentum of the two-cart system after the collision is

(1) 0.0 kg•m/s (2) 6.0 kg•m/s (3) 15 kg•m/s (4) 30. kg•m/s

37. The diagram below shows a 10.0-kilogram mass held at rest on a frictionless 30.0° incline by force *F*.



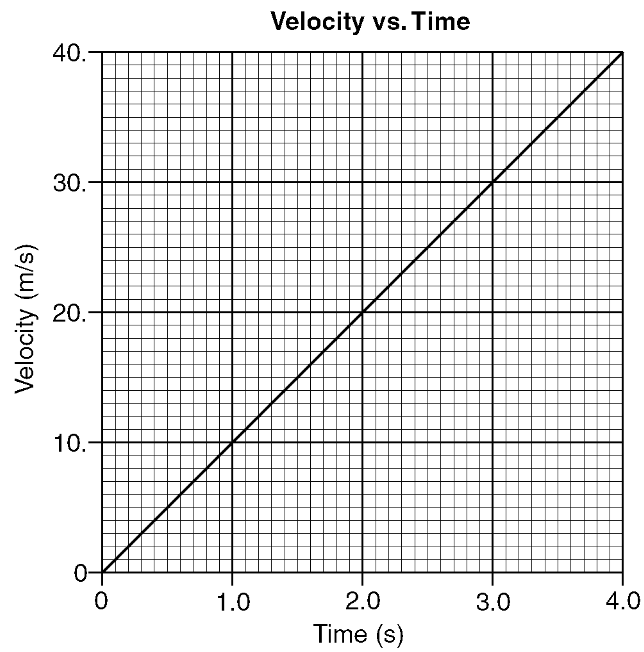
What is the approximate magnitude of force *F*?

(1) 9.81 N (3) 85.0 N
(2) 49.1 N (4) 98.1 N

38. An archer uses a bow to fire two similar arrows with the same string force. One arrow is fired at an angle of 60.° with the horizontal, and the other is fired at an angle of 45° with the horizontal. Compared to the arrow fired at 60.°, the arrow fired at 45° has a

(1) longer flight time and longer horizontal range
(2) longer flight time and shorter horizontal range
(3) shorter flight time and longer horizontal range
(4) shorter flight time and shorter horizontal range

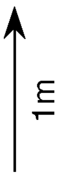
39. The graph below shows the velocity of a race car moving along a straight line as a function of time.

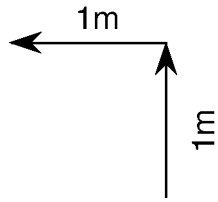


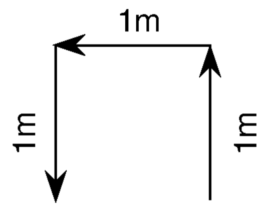
What is the magnitude of the displacement of the car from t = 2.0 seconds to t = 4.0 seconds?

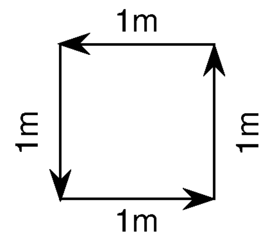
(1) 20. m (3) 60. m
(2) 40. m (4) 80. m

40. Which vector diagram represents the greatest magnitude of displacement for an object?

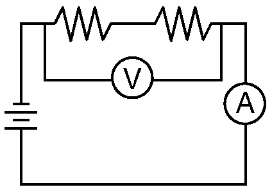
(1)


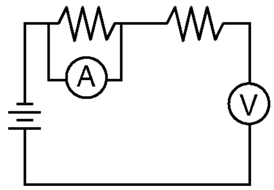
(2)


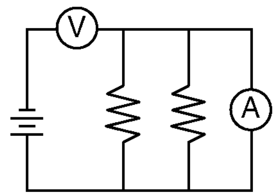
(3)


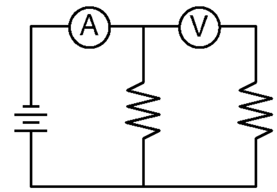
(4)


41. Which circuit diagram shows voltmeter V and ammeter A correctly positioned to measure the total potential difference of the circuit and the current through each resistor?

(1)


(2)


(3)


(4)


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42. A monochromatic ray of light ($f = 5.09 \times 10^{14}$ hertz) traveling in air is incident upon medium A at an angle of 45°. If the angle of refraction is 29°, medium A could be

(1) water
(2) fused quartz
(3) Lucite
(4) flint glass

43. What is the total electrical energy used by a 1500-watt hair dryer operating for 6.0 minutes?

(1) 4.2 J
(2) 250 J
(3) $9.0 \cdot 10^3$ J
(4) $5.4 \cdot 10^5$ J

44. Which combination of quarks would produce a neutral baryon?

(1) uud
(2) udd
(3) $\bar{u}\bar{u}d$
(4) $\bar{u}dd$

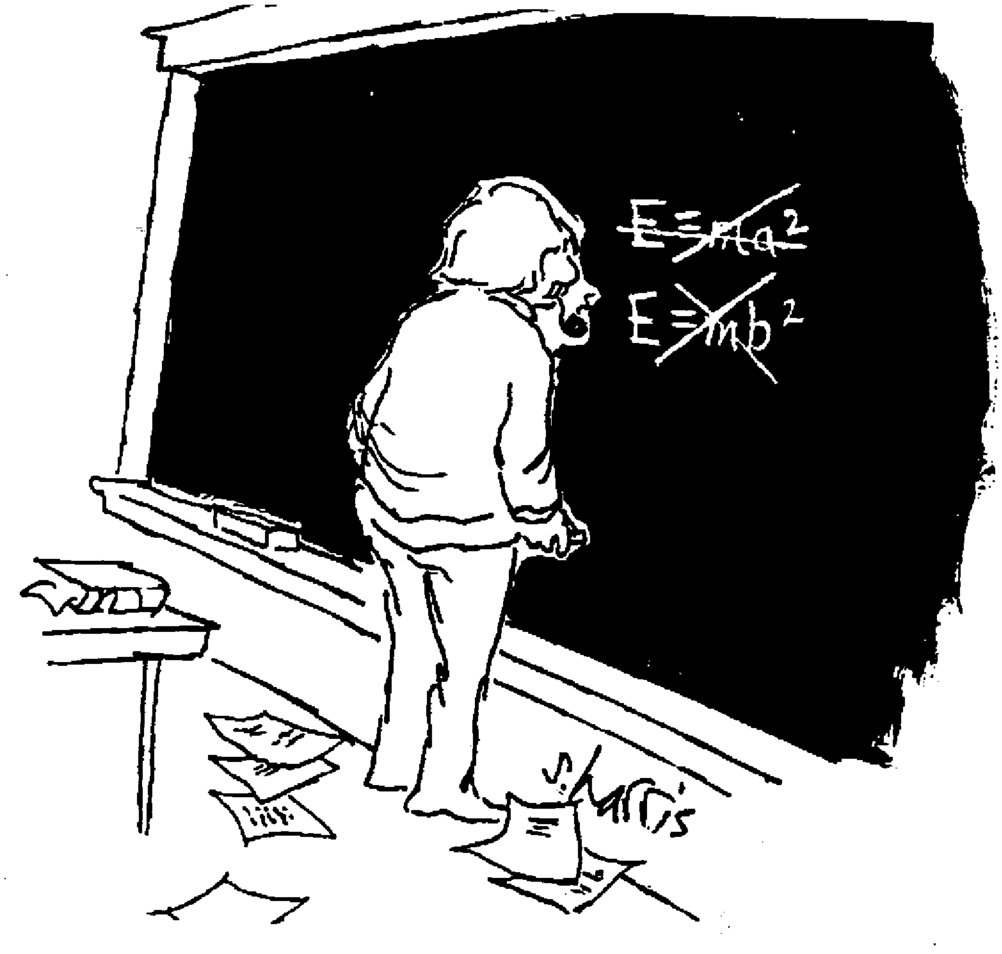
45. A 12.0-meter length of copper wire has a resistance of 1.50 ohms. How long must an aluminum wire with the same cross-sectional area be to have the same resistance?

(1) 7.32 m
(2) 8.00 m
(3) 12.0 m
(4) 19.7 m

46. A 0.500-meter length of wire with a crosssectional area of 3.14×10^{-6} meters squared is found to have a resistance of 2.53×10^{-3} ohms. According to the resistivity chart, the wire could be made of

(1) aluminum
(2) copper
(3) nichrome
(4) silver

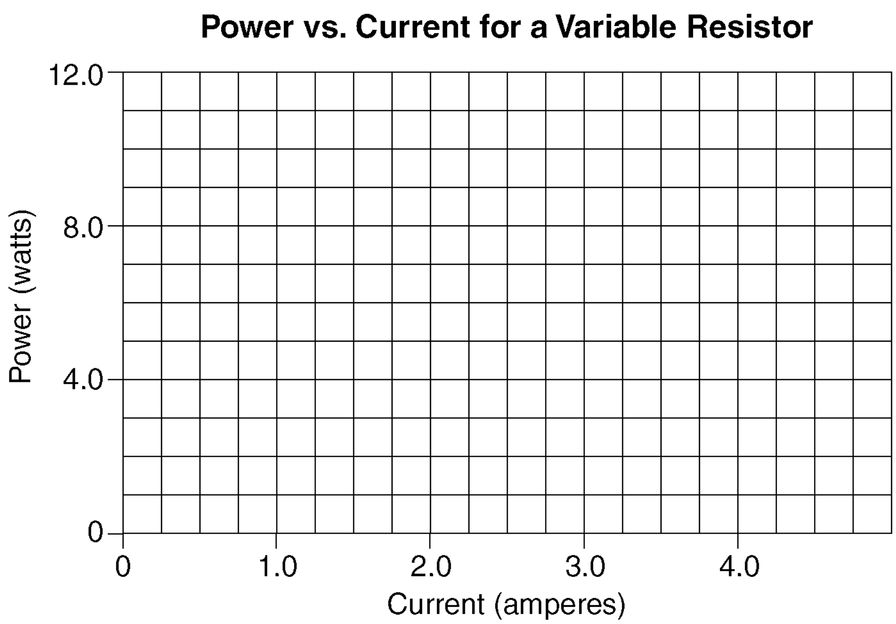
47. Base your answer to the following question on the cartoon below and your knowledge of physics.



In the cartoon, Einstein is contemplating the equation for the principle that
(1) the fundamental source of all energy is the conversion of mass into energy
(2) energy is emitted or absorbed in discrete packets called photons
(3) mass always travels at the speed of light in a vacuum
(4) the energy of a photon is proportional to its frequency

Base your answers to questions **48** through **51** on the information and data table below.

A variable resistor was connected to a battery. As the resistance was adjusted, the current and power in the circuit were determined. The data are recorded in the table below.



Current (amperes)	Power (watts)
0.75	2.27
1.25	3.72
2.25	6.75
3.00	9.05
4.00	11.9

48. Using the information in the data table, construct a line graph on the grid provided *above*, following the directions below.

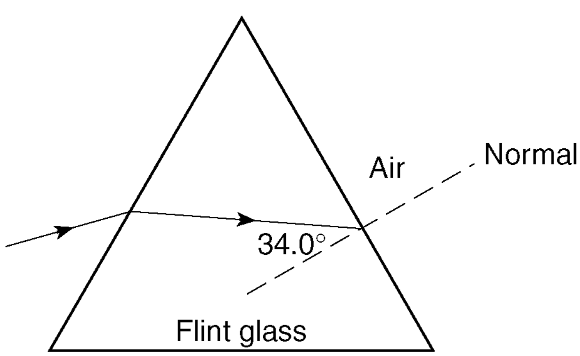
a Plot the data points for power versus current.
b Draw the best-fit line.

49. Using your graph, determine the power delivered to the circuit at a current of 3.5 amperes.

50. Calculate the slope of the graph. [Show all calculations, including the equation and substitution with units.]

51. What is the physical significance of the slope of the graph?

Base your answers to questions **52** through **54** on the diagram below which shows a ray of monochromatic light ($f = 5.09 \times 10^{14}$ hertz) passing through a flint glass prism.

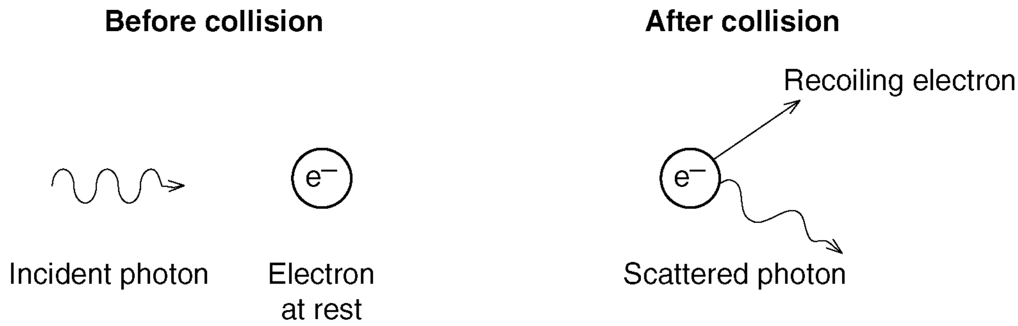


52. Calculate the angle of refraction (in degrees) of the light ray as it enters the air from the flint glass prism. [Show all calculations, including the equation and substitution with units.]

53. Using a protractor and a straightedge, construct the refracted light ray in the air on the diagram *above*.

54. What is the speed of the light ray in flint glass?
(1) 5.53×10^{-9} m/s
(2) 1.81×10^{8} m/s
(3) 3.00×10^{8} m/s
(4) 4.98×10^{8} m/s

Base your answers to questions **55** and **56** on the information and diagram below. The diagram shows the collision of an incident photon having a frequency of 2.00×10^{19} hertz with an electron initially at rest.



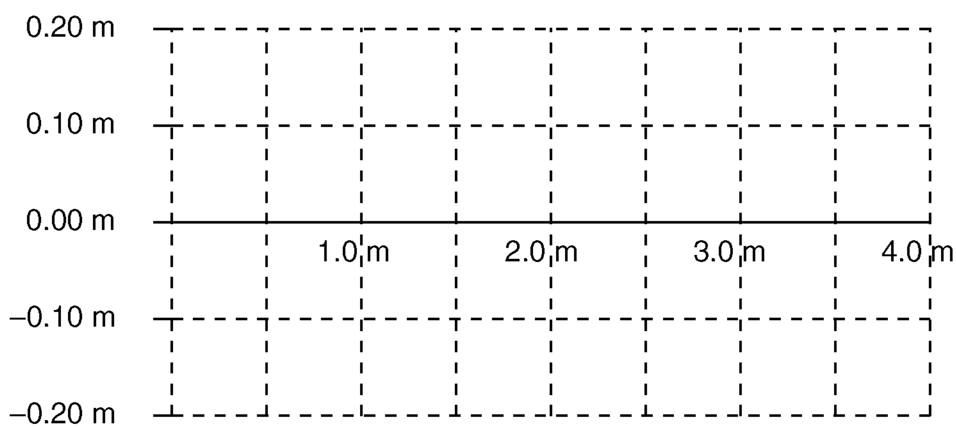
55. Calculate the initial energy of the photon. [Show all calculations, including the equation and substitution with units.]

56. What is the total energy of the two-particle system after the collision?

57. Determine the color of a ray of light with a wavelength of 6.21×10^{-7} meter.

Base your answers to questions **58** and **59** on the information below.

A periodic transverse wave has an amplitude of 0.20 meter and a wavelength of 3.0 meters.

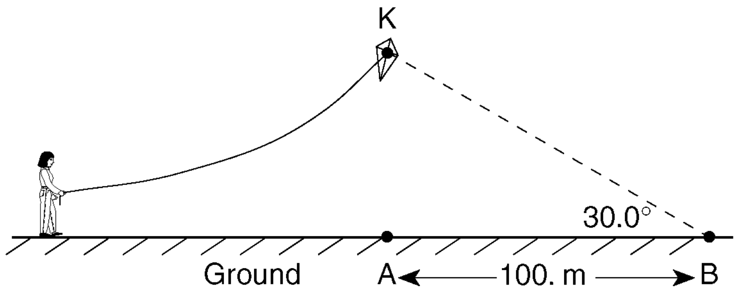


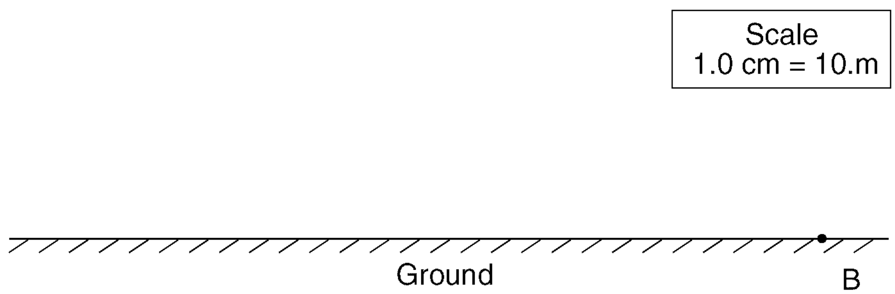
58. On the grid provided *above*, draw at least one cycle of this periodic wave.

59. If the frequency of this wave is 12 Hz, what is its speed?
(1) 0.25 m/s (2) 12 m/s (3) 36 m/s (4) 4.0 m/s

Base your answers to questions **60** through **62** on the information and diagram below.

A child is flying a kite, *K*. A student at point *B*, located 100. meters away from point *A* (directly underneath the kite), measures the angle of elevation of the kite from the ground as 30.°.





60. *In the space provided above*, use a metric ruler and protractor to draw a triangle representing the positions of the kite, *K*, and point *A* relative to point *B* that is given. Label points *A* and *K*. Use a scale of 1.0 centimeter = 10. meters.

61. Use a metric ruler and your scale diagram to determine the height, *AK*, of the kite.

62. A small lead sphere is dropped from the kite. Calculate the amount of time required for the sphere to fall to the ground. [Show all calculations, including the equation and substitution with units. Neglect air resistance.]

Base your answers to questions **63** and **64** on the information given below.

Friction provides the centripetal force that allows a car to round a circular curve.

63. Find the minimum coefficient of friction needed between the tires and the road to allow a 1600-kilogram car to round a curve of radius 80. meters at a speed of 20. meters per second. [Show all work, including formulas and substitutions with units.]

64. If the mass of the car were increased, how would that affect the maximum speed at which it could round the curve?

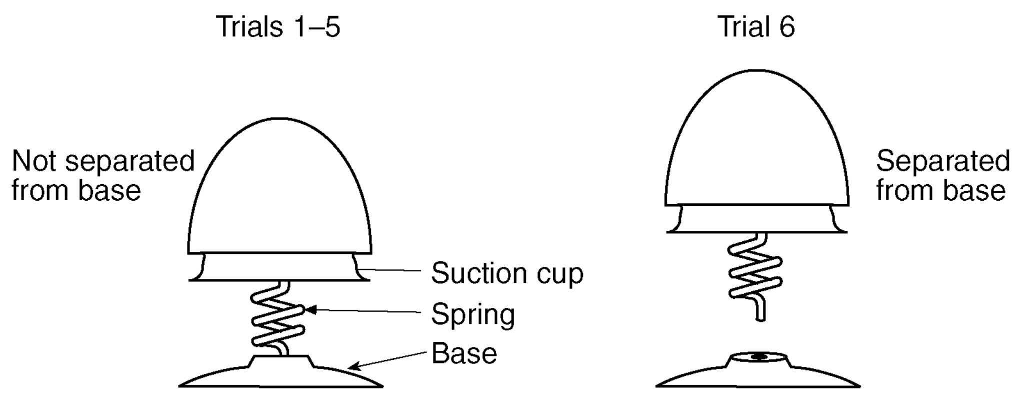
Base your answers to questions **65** and **66** on the information below and on your knowledge of physics.

Using a spring toy like the one shown in the diagram, a physics teacher pushes on the toy, compressing the spring, causing the suction cup to stick to the base of the toy.

When the teacher removes her hand, the toy pops straight up and just brushes against the ceiling. She does this demonstration five times, always with the same result.

When the teacher repeats the demonstration for the sixth time the toy crashes against the ceiling with considerable force. The students notice that in this trial, the spring and toy separated from the base at the moment the spring released.

The teacher puts the toy back together, repeats the demonstration and the toy once again just brushes against the ceiling.



65. Describe the conversions that take place between pairs of the three forms of mechanical energy, beginning with the work done by the teacher on the toy and ending with the form(s) of energy possessed by the toy as it hits the ceiling. [Neglect friction.]

66. Explain, in terms of mass and energy, why the spring toy hits the ceiling in the sixth trial and not in the other trials.

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67. Your school's physics laboratory has the following equipment available for conducting experiments:

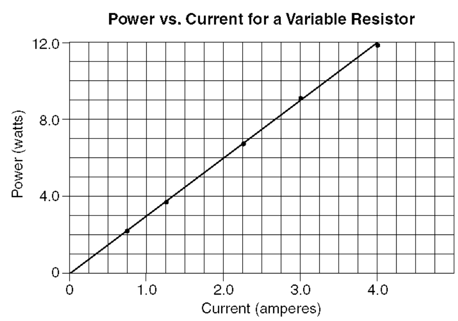
accelerometers	lasers	stopwatches
ammeters	light bulbs	thermometers
bar magnets	meter sticks	voltmeters
batteries	power supplies	wires
electromagnets	spark timers	

Explain how you would find the resistance of an unknown resistor in the laboratory. Your explanation must include:

a Measurements required
b Equipment needed
c Complete circuit diagram
d Any equation(s) needed to calculate the resistance

Answer Key

1. 4
2. 2
3. 3
4. 4
5. 3
6. 3
7. 1
8. 1
9. 1
10. 2
11. 2
12. 1
13. 2
14. 4
15. 1
16. 4
17. 2
18. 3
19. 3
20. 2
21. 3
22. 2
23. 3
24. 1
25. 4
26. 3
27. 3
28. 1
29. 1
30. 4
31. 3
32. 2
33. 1
34. 1
35. 1
36. 2
37. 2
38. 3
39. 3
40. 2
41. 1
42. 2
43. 4
44. 2
45. 1
46. 4
47. 1
48.



49. 10.5 W

50.

$$\text{slope} = \frac{\Delta P}{\Delta I}$$

or

$$\text{slope} = \frac{\Delta Y}{\Delta X}$$

$$\text{slope} = \frac{10.5\ \text{W} - 0.0\ \text{W}}{3.5\ \text{A} - 0.0\ \text{A}}$$

$$\text{slope} = 3.0\ \text{V}$$

Answer Key

51. examples:
– voltage – potential difference

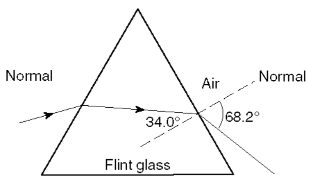
52. $n_1 \sin \theta_1 = n_2 \sin \theta_2$

$$\sin \theta_2 = \frac{n_1 \sin \theta_1}{n_2}$$

$$\sin \theta_2 = \frac{1.66 \sin 34.0°}{1.00}$$

$$= 68.2° \ or = 68°$$

53.



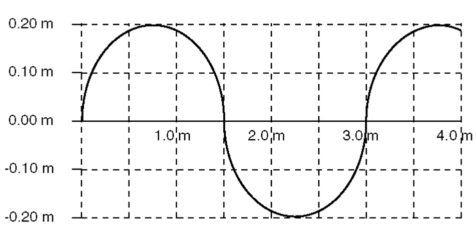
54. ____2____

55. $E_{photon} = hf$
$E = (6.63 \times 10^{-34}\ \text{J•s})(2.00 \times 10^{19}\ \text{Hz})$
$E = 1.33 \times 10^{-14}$ *or* $E = 13.3 \times 10^{-15}\ \text{J•s•Hz}$

56. examples:
– It is the same as the energy of the system before the collision.
– Energy is conserved.
– The energy is the same as before the collision.

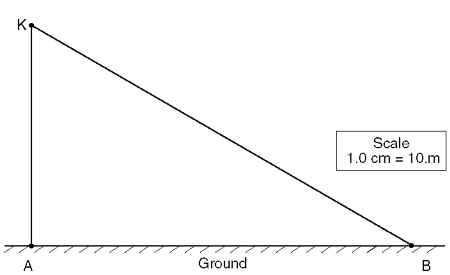
57. orange

58.



59. ____3____

60.



61. 58 m

62. $d = v_i t + \frac{1}{2}at^2 \ or \ d = \frac{1}{2}at^2$

$$t = \sqrt{\frac{2d}{a}}$$

$$t = \sqrt{\frac{2(58\ \text{m})}{9.81\ \text{m/s}^2}}$$

$$t = 3.4\ \text{s}$$

63. Formulas: $F_f = \mu F_N$ $F_N = mg$ $F_c = \frac{mv^2}{r}$

Rearrangement: $\mu = \frac{v^2}{rg}$

Substitution: $\mu = \frac{(20.\ \text{m/s})^2}{(80.\ \text{m})(9.8\ \text{m/s}^2)}$

Answer: $\mu = 0.51$

or

$F_c = ma_c \quad a_c = \frac{v^2}{r}$

$$F_c = \frac{mv^2}{r} = \frac{(1{,}600\ \text{kg})(20.\ \text{m/s})^2}{80.\ \text{m}} = 8.0 \times 10^3\ \text{N}$$

$$F_N = mg = (1{,}600\ \text{kg})(9.81\ \text{m/s}^2) = 1.6 \times 10^4\ \text{N}$$

$$F_f = F_c$$

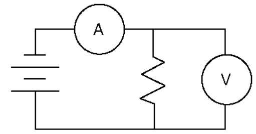
$$F_f = \mu F_N \quad \mu = \frac{F_f}{F_N} = \frac{8.0 \times 10^3\ \text{N}}{1.6 \times 10^4\ \text{N}} = 0.50$$

64. Changing the mass of the car would have no effect on the maximum speed at which it could round the curve.

65. examples:
– work of teacher into the P.E. (spring) into the K.E.of launch into P.E. (gravity) and sound energy.

66. examples:
– The toy has less mass without the base but the same energy. Therefore it can go higher.
– The work put into the toy is the same but the mass is less. With less mass the toy could go higher because it is moving faster.

67.



a To determine the resistance of an unknown resistor, I would need to measure the current and potential difference for the resistor in a circuit.
b The equipment I would need would be the resistor, an ammeter, a voltmeter, a battery or power supply, and connecting wires.
c The circuit would be connected as in the diagram *above*.
d Once I measured the current and potential for the resistor, I would use the formula for Ohm's law (R = V/I) to calculate the resistance.

Category Print

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Physics Sample Exam

Name ________________________________ Class __________________________ Date ___________

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